Space Weather Technical Forecast

Issued on Thursday, 25 November 2021 at 12:26 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1 later in UTC weekend.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low over the past 24 hours, with no X-ray flares of note. There is currently one active region on the visible disc, AR2898 in the southeastern quadrant. This group saw some proliferation and growth in its trailing spots in the period, with the whole group spreading in latitude, reaching Dai/Beta classification by the period's end.

The southern solar hemisphere is showing reasonably stark opposing regions of magnetic field at the moment, with filaments consequently larger and more numerous here, although for the time being those that are present here appear stable. A rear-sided Coronal Mass Ejection (CME) was visible leaving the eastern limb on coronagraph imagery in the period, however no new Earth-directed CMEs were identified in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind was characteristic of the decaying influence of a fast regime, probably that emanating from coronal hole 20, with the phi angle accordingly towards the sun throughout (negative). Solar wind speeds, as measured by DSCOVR at L1, showed a flat or perhaps very weak decline in the period, with an erratic oscillation about 450km/s, with limits between 475 and 425. The solar wind density was unremarkable in high single figures ppcc, while the IMF peaked at 6nT, with a north-south component between +/-5nT.

The net result of the above solar wind measures was provisionally Quiet geomagnetic activity throughout, with Kp peaking at '2o' in the 03-06UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels. The high energy electron flux (greater than 2 MeV) was at predominantly Moderate levels, but reached High levels through the diurnal cycle, with 1610 pfu recorded at 24/1605UTC. Associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), with a now levelling trend. 6.8e7 integrated pfu was recorded at 25/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be at Low or Very Low levels, with a now slightly increased daily Chance of C-class flares owing to growth in the current sole facing-side sunspot.

Solar Wind / Geomagnetic Activity: A CME from a filament eruption leaving the sun 24/1300UTC may reach Earth around the turn of the UTC days Saturday 27 into Sunday 28 November, i.e. around 27/2300UTC. There is considered a Chance of G1 from this event, probably peaking within the UTC day of Sunday 28 November.

Mainly Quiet geomagnetic activity is otherwise expected for the next couple of days, but with an

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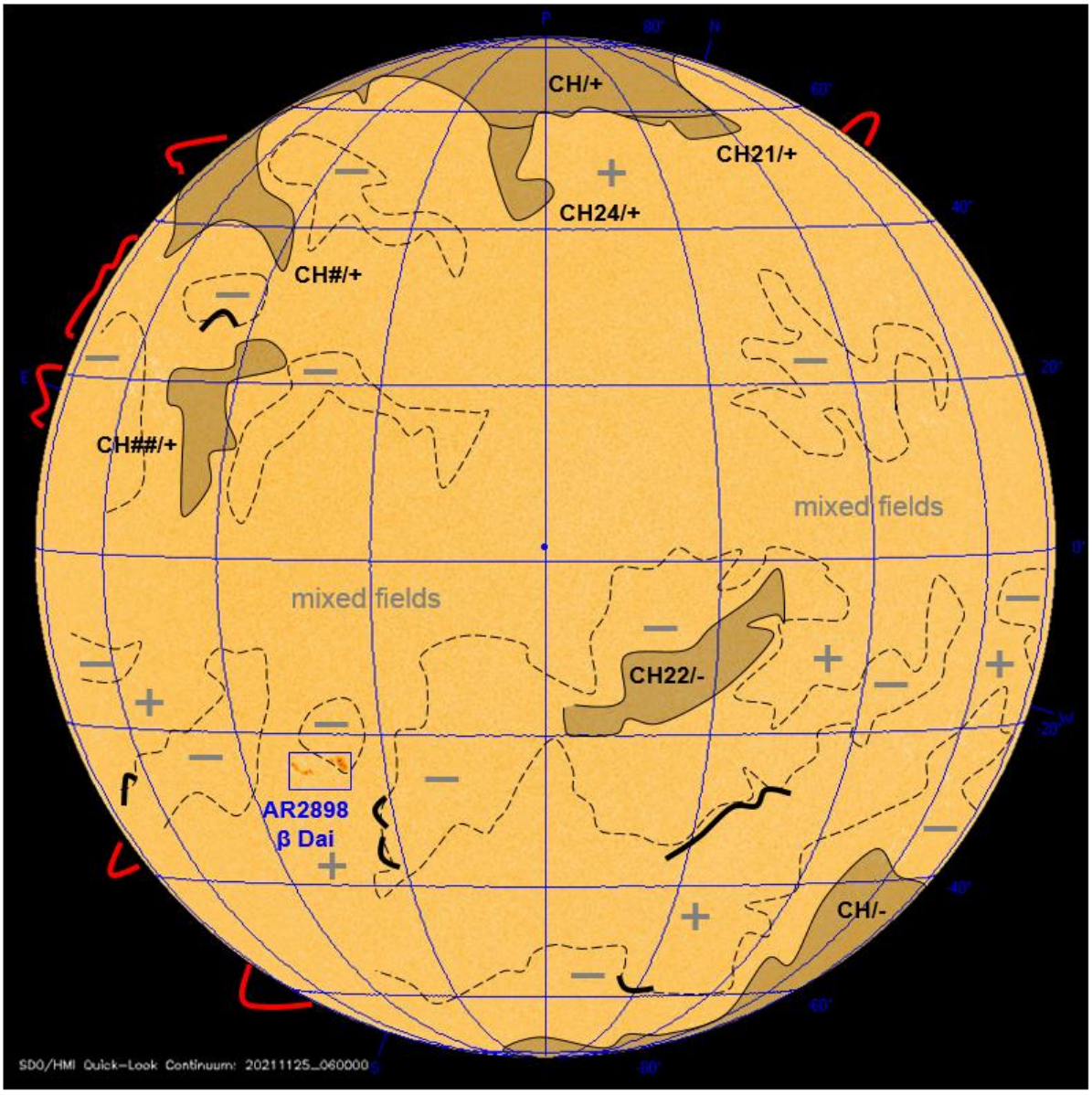
increased chance Active intervals from late day 3 (Saturday 27 November), and especially as the UTC transitions into Sunday, with a peak Chance of G1 Minor Geomagnetic storm intervals by this time.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) is expected to continue to exceed High levels through the diurnal cycle. There is accordingly a Slight Chance of associated 24-hour integrated fluence reaching the Active threshold from Day 2 (Friday 26 November).

Figure 1. Solar Analysis Valid 25/0600UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption observed in the southeastern quadrant around 24/1300UTC has resulted in a CME with a possible Earth-directed component. This feature is currently forecast to reach Earth around the turn of the UTC days Saturday 27 into Sunday 28 November, i.e. around 27/2300UTC. The ejecta appears to be angled mostly below the ecliptic plane as well as slightly eastward, which lowers confidence in effects slightly, however on balance there is considered a Chance of G1, probably peaking within the UTC day of Sunday 28 November.

The unperturbed solar wind should otherwise see a continued gradual exit of the long-lasting influence of Coronal Hole 20. STEREO A MAG and PLASTIC data then hints at a now imminent SSBC into a positive polarity stream of solar wind, possibly that from CH21, with the IMF approaching 10nT in recent data. Because of orbital latitude differences between Earth and STEREO however (4 degrees difference), this solar wind observed at Earth may instead consist of a segue from CH20 into CH22, with the transition perhaps indistinguishable from CH20 into the more muted second negative polarity coronal hole (22). Overall, the coronal hole forecast is therefore of low confidence for detail, but higher for the expected lack of G1 throughout.

To summarise, mainly Quiet geomagnetic activity is therefore expected for the next couple of days, with an increased chance Active intervals from late day 3 (Saturday 27 November), and especially as the UTC transitions into Sunday, with a peak Chance of G1 Minor Geomagnetic storm intervals by this time.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	10	30
Strong	G3	No	1	1	1	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
24/2058UTC	Partial Halo	Filament Eruption	SE Quadrant	500	27/2300UTC	Mainly angled below and behind Earth in orbit

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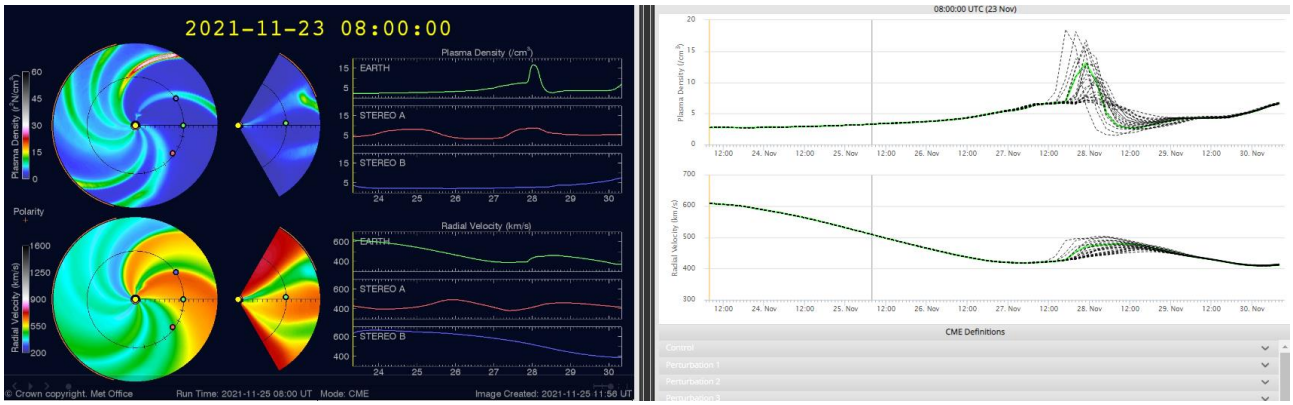
Figure 2: Latest MOSWOC Enlil and Ensemble output, showing deterministic run arrival around 27/2300UTC. The ensemble suggests that this is roughly mid range in both intensity and temporally, and is accepted with the margin for error noted.



Radio Blackouts - X-Ray Flares:

Solar activity is currently Very Low, and expected to remain at Low or Very Low levels. The current sole occupant of the Earth-facing disc - AR2898 - showed some limited growth in the past 24 hours, becoming a tenuous Dai/Beta at peak, although this did not translate into flare activity. On paper, its class implies C-class flares may be Likely day-on-day, however this has been adjusted downwards to perhaps a 30% risk given subdued observations.

Ex-2893 is perhaps a day away from arriving over the northeastern solar horizon, but appears to be preserved in at least plage-form on the latest STEREO A EUVI 195 imagery. This possible group does not feature in the current daily probabilities, which instead show a flat trend for significant flares through the coming four days.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

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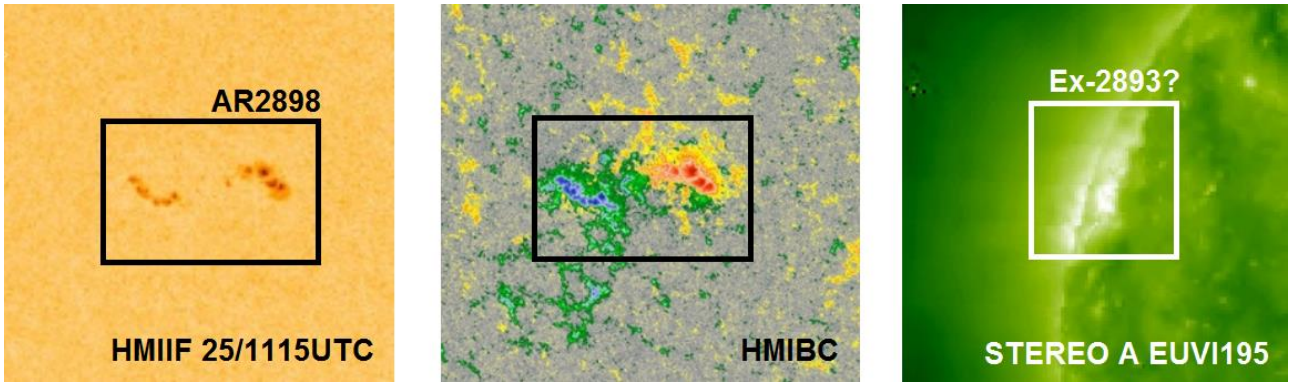
Figure 3: Imagery of current sole front-sided sunspot region and a possible returning region due in the period.



Solar Radiation Storms - (High Energy Protons):

In the absence of any significant flare activity, the high energy proton flux (greater than 10 MeV) is forecast to remain at background levels, with no solar radiation storms anticipated.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):

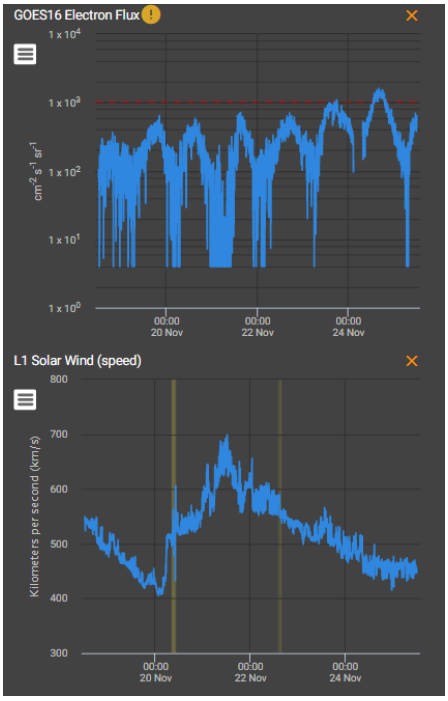
The high energy electron flux (greater than 2 MeV) as measured by GOES-16 at GEO reached High levels at the peak of the diurnal cycle. A daily repeat of this pattern is likely into the coming UTC weekend, before apparently attenuating should the forecast 24 November CME arrive.

Corresponding electron fluence will probably remain below the Active threshold (1e8 integrated pfu) throughout the four-day period, with CH20's effects expected to have manifested themselves by now, with the result perhaps unexpectedly low flux and fluence for what was a 700km/s peak wind speed.

Recent MOSWOC REFM output has revised its fluence forecast downward to remain below threshold, and these thoughts are accepted.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	10	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Past week in GOES 16 high energy electron flux and L1 solar wind speed, showing the response in electrons to CH19 and then CH20 in turn. The current flux appears to be running below 24 hours ago, hence a relative reduction in risk going into the end of the coming week (given the lack of geomagnetic activity to continue to 'suppress' counts.



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